

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

GUIDE FOR QUALITY CONTROL AND ACCEPTANCE REQUIREMENTS FOR ASPHALT
MIXTURES ON SPECIFIED INTERSTATE AND EXPRESSWAY PROJECTS

1. PURPOSE

- 1.1 Provide a method for daily monitoring and quality assurance of Superpave and Marshall asphalt mixtures.
- 1.2 Provide guidelines for adequate acceptance plans.
- 1.3 Provide plant personnel with criteria upon which to base decisions of continuing or ceasing plant production.
- 1.4 Provide field personnel with criteria upon which to base decisions of accepting or rejecting of material.
- 1.5 Provide an equitable and uniform method for determining compliance or non-compliance with project specifications, and calculating corresponding price adjustments.

2. SCOPE

- 2.1 This acceptance procedure shall be applicable to all large quantity Superpave and Marshall asphalt mixture types relative to compliance with Job Mix Formula (JMF) acceptance limits as specified in the governing specifications.

3. DEFINITIONS

- 3.1 Job Mix Formula – The specification for a single mix produced at a single plant. This mix may be used on a single project or on multiple projects if the basic design criteria (design compaction level and PG Binder grade) are the same.
- 3.2 Lot – The amount of material that is to be judged acceptable or unacceptable on the basis of a sample comprised of the specified number of test results. For acceptance decisions in this materials procedure a normal Lot size is 2,500 tons (2270 Mg) unless operational conditions or project size dictate otherwise.
- 3.3 Sublot – Equal subdivisions of the Lot used for stratified random sampling and testing. For this materials procedure a normal Sublot size is 500 tons (450 Mg) unless operational conditions or project size dictate otherwise.

- 3.4 Field Design Verification Samples and Tests - Those samples taken and tests performed by the contractor to verify that a mix design can be produced within the limits of the criteria set forth by this Materials Procedure. These samples are taken during the initial use of each mix design or whenever circumstances described in this MP require a new field design reverification. These samples should not be confused with the Division verification samples that are used for acceptance purposes.
- 3.5 Quality Control Samples and Tests - Those samples taken and tests performed by the Producer/Contractor to monitor and control the production of this product.
- 3.6 Verification Samples and Tests - Those samples taken and tests performed by the Division to determine specification compliance of the contractor's quality control testing.
- 3.7 Acceptance Samples and Tests – Those samples taken and tests performed by the Division that are used to determine whether or not a price adjustment is required on a Lot of asphalt pavement.

4. DOCUMENTATION

- 4.1 The Contractor shall maintain adequate records of all testing and records of any production changes required to control their product. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, and the nature of corrective action taken. The Contractor's documentation procedures will be subject to the review and approval of the Division at any time during the progress of the work being performed.
 - 4.1.1 All asphalt mixture component materials shipped to the plant must have proper documentation which identifies the type and source of each material. This information shall be made accessible to the Division for review at any time.
- 4.2 Forms and Distribution: All test data shall be documented on forms provided by the Division. The original copy of the form shall be delivered to the District Materials Supervisor. One copy of each completed form is to be retained by the contractor until the project is completed. Testing shall be conducted using only the approved test methods listed in Section 401.5 of the Standard Specification unless specified otherwise in this MP or other contract documents. Asphalt content and gradation test results shall be recorded on form T417. Mix design property test results shall be recorded on form T419 for Superpave mixtures and form T406 for Marshall mixtures.
- 4.3 When the Contractor produces materials or products that do not conform to the requirements of the contract documents, the Contractor shall take prompt action to correct the resulting conditions, and to prevent undesirable conditions that may

result. The Contractor shall establish a detailed plan of action regarding the disposition of non-specification material.

- 4.3.1 In the event that non-specification material is incorporated into the project, the Contractor shall notify the Division immediately and shall supply to the Division a detailed description of the non-specification materials and where they were placed. The Division shall then evaluate the effects of inclusion of the non-specification material and act accordingly. Refer to MP 401.07.25 for additional guidance.
- 4.3.2 All applicable QA/QC forms and worksheets can be found on the MCS&T web page at the following link:
<http://www.transportation.wv.gov/highways/mcst>

5. JOB MIX FORMULA FIELD DESIGN VERIFICATION

- 5.1 For each paving season, during the initial production of each JMF, field design verification shall be conducted during the first days of plant production for the purpose of demonstrating that the mix can be produced within the specified tolerances set forth in this MP.
- 5.2 This field design verification shall consist of a randomly selected asphalt mixture sample taken in accordance with the AASHTO T168 truck bed sampling method for each 750 tons (680 Mg) delivered to the project with a maximum of three samples in one day. A minimum of three samples are required for verification, however, up to three additional samples are required if none of the first three individual samples and the average of the three samples are completely within the tolerance limits of Table-A.
 - 5.2.1 If the Contractor desires, field design verification sampling can be moved to the roadway to coincide with the Division's sampling rate as long as samples are taken at the same time and location as the Division's verification samples are taken as described in the sampling materials procedure, MP 401.07.20. When roadway samples are taken for field design verification they will be taken at a rate of one sample for every 500 ton (450 Mg) delivered to the project with a maximum of four samples (if needed) in one day. If the roadway samples are only used for percent asphalt and gradation analysis then a separate sample taken at the same production rate shall be taken from the truck bed at the plant for volumetric testing. If the roadway sampling method is used skip to Section 5.5.
- 5.3 Use a random number table or calculator that generates random numbers to select the tonnage at which to sample. Do not take a sample within the first 100 tons (90 Mg) of production during the day unless it consists of mixture that remained in the storage silo in accordance with WVDOT specification from the previous production day. For all new production material for the day, take the first sample from the first loaded truck following the truck containing the 100th ton (90th Mg) produced.

5.3.1 Example sampling calculations: 750 tons x random number = tonnage to sample

First Sublot Sample = $750 \times .215$ (random number) = 161

First sample would be taken from the truck that contains the 161st ton of mixture produced for the day.

Second Sublot Sample = $750 \times .521$ (random number) = 391

Second sample would be taken from the truck that contains the 391st ton from this second Sublot after the first 750 tons; therefore the tonnage would be $750 + 391 = 1141$.

- 5.4 When a Sublot is going to represent less than 750 ton (680Mg) but at least 200 tons (180 Mg) estimate the tonnage to determine the random sample tonnage.
- 5.5 Do not conduct field design verification testing on a sample that represents less than 200 tons (180 Mg). Wait until the next production day to take the next sample, and proceed as described in Section 5.8.
- 5.6 Samples used for gradation analysis during the verification process shall be obtained from the asphalt ignition oven samples (AASHTO T308). For each mix design, an asphalt content correction factor and any required gradation correction factors (due to aggregate breakdown) shall be determined in accordance with AASHTO T-308. This correction information, along with the ignition oven model and identification number, shall be submitted to the District Materials Section on Form T416 prior to beginning the verification process each year and anytime thereafter that new correction factors are determined.
- 5.7 The maximum specific gravity of each test sample shall be calculated and the average value of the test samples for each day shall be presented to the DOH for use as the target maximum density of the mixture for determining the density of the project cores taken on the same day. In the event that both QC testing and field design verification are performed during the same day, use the average of all maximum specific gravity test results.
- 5.8 In the event that less than 200 tons (180 Mg) of mixture are produced then field design verification testing shall not be conducted on that day. In such cases a single sample shall be taken to determine the asphalt content and gradation analysis of the mixture and the results shall be compared to the single sample requirements of Table-A. This sample will not count toward verification of the mixture.

- 5.9 The quality control and field design verification requirements are listed in Table-A. Field design verification test results shall be documented on Form T408 for Marshall mixtures and Form T419 for Superpave mixtures. Gradation results for all sieve listed in the JMF design gradation tables shall be documented on Form T421.
- 5.10 After each of the field design verification samples is tested, the results shall be evaluated to determine conformance to the requirements of Table-A. If any test results fall outside the allowable tolerance limits then steps must be taken to make production adjustments to bring the mix back to within specification limits. During this verification process, the target asphalt content of the mixture may be adjusted by no more than $\pm 0.2\%$ from the approved JMF value. During this verification process, the target percent passing the 75 μm (No. 200) sieve of the mixture may be adjusted by no more than $\pm 1.0\%$ from the approve JMF value. Any final adjustment made to the target asphalt content or the percent passing the 75 μm (No. 200) sieve after field design verification is completed shall remain the new target until a new verification is performed.
- 5.10.1 The contractor will be allowed to adjust the asphalt content used at the plant within $\pm 0.3\%$ of the target asphalt content in order to achieve the desired target asphalt content for the JMF as determined from the field acceptance samples. At the same time, all of the requirements of Table-A must still be met during field design verification and quality control testing.
- 5.10.2 The maximum allowable aggregate blend change for a mix design shall be $\pm 10\%$ from the original approved design quantity on any individual aggregate component with the two exceptions as follows:
- a) The maximum allowable increase of natural sand shall be 5% on Marshall mixes designed for 3 million ESALs or greater
 - b) The amount of RAP used in a mix design shall not be increased from the original approved value.
- 5.10.3 When an aggregate blend change of more than 5% on any single aggregate component is required, the Contractor shall evaluate the mix to determine whether or not the volumetric properties, the FA ratio, and gradation are adversely affected by the change in blended aggregates. Also, for Superpave mixtures, the coarse and fine aggregate angularities must be determined. When available, current individual stockpile angularity results may be used to calculate the angularity of the aggregates.
- 5.10.4 Since the VMA of the mix may also be affected by this blend change, a new blended aggregate bulk specific gravity shall be calculated from the latest available specific gravity test data of the individual component aggregates. The calculations used in this evaluation shall be provided to the District. The District will review and verify the results of this evaluation. If the District determines that any of the above

mentioned properties are adversely affected by the blend adjustment then they may revoke the change in the JMF. If the JMF gradation tolerances and volumetric properties cannot be maintained with or without these aggregate blend changes, then the contractor will be required to provide a new mix design.

- 5.10.5 Under no circumstances shall a blend change be allowed that will cause the target gradation to fall outside of the allowable tolerances of the approved mix design.
- 5.10.6 If, after three samples the design criteria and gradation requirements of at least one of the samples plus the average of the three samples is within all of the allowable tolerance limits of Table-A then verification of the design is complete. If the criteria are not met, then up to an additional three samples shall be tested. If the fourth, fifth, or sixth sample plus the average meet all testing requirements, then field design verification is complete. If, after six samples, the Division determines that the mix cannot be produced within specification limits, then production of this mix design shall be discontinued and a new mix design will be required.
- 5.11 When determining the moving average, the initial average shall be based on three samples, then four samples, and finally five samples. When the sixth sample is taken, the test values of the first sample are dropped and the average shall consist of the results for the second thru sixth samples.
- 5.12 If the initial field verification procedure is successful for a mix design then the approved mix design may be used on other paving projects during the year without reverification. In addition, any mix design that has been verified using the Standard Section 401 Specification requirements may be used on these special provision projects as long as it can be shown that all criteria from Table-A of this MP has been met.
- 5.13 During the JMF field verification process, mixture acceptance by the Division shall be in accordance with the acceptance procedures described in Section 7 of this MP.
- 5.14 All approved mix designs shall be reverified on the first project on which they are used in any subsequent years as long as there are no changes to the design specifications that would require a new mix design. The original mix design percent asphalt and aggregate blend percentages shall remain the starting point for making any allowable mix adjustments. In addition, stockpile aggregate specific gravities shall be performed and the blended aggregate bulk specific gravity shall be determined before reverification begins.

TABLE-A
Mix Property Field Design Verification and
Quality Control Requirements ^{Note-1}

Test Property	Single Sample Tolerances	Multiple Sample Tolerance (3 to 5 samples with 5 sample moving average)
Asphalt Content (%) for 25 mm, 37.5 mm, & Base-1 mixtures	JMF $\pm$ 0.7 %	JMF $\pm$ 0.5 %
Asphalt Content (%) for all other standard mix types	JMF $\pm$ 0.6 %	JMF $\pm$ 0.4 %
Air Voids (%)	JMF $\pm$ 1.8 %	JMF $\pm$ 1.5 %
Voids in Mineral Aggregate (VMA) %	JMF $\pm$ 2.0 %	JMF $\pm$ 1.5 %
Stability (Newtons) ^{Note-2}	Minimum Design Criteria	Minimum Design Criteria
Flow (0.25 mm) ^{Note-2}	Limits of Design Criteria	Limits of Design Criteria
Percent Passing the Nominal Maximum Sieve for the Design	JMF Lower Target Limit - 2 %	JMF Target Range
Percent Passing the Sieve Below the NMS for the Design ^{Note-3, Note-4 and Note-5}	92 % Max	90 % Max
Percent Passing 2.36 mm (No. 8) Sieve ^{Note-6}	JMF Target Range $\pm$ 2 %	JMF Target Range
Percent Passing the 75 μ m (No. 200) Sieve	JMF Target $\pm$ 3.0 %	JMF Target $\pm$ 2.0 %

Note-1: Targets established on T400 or T400 SP.

Note-2: Marshall mixtures only.

Note-3: For a 4.75 mm mixture the single sample tolerance for the sieve above the nominal maximum sieve shall be the JMF Lower Target Limit - 2 % and the multiple sample tolerance shall be the JMF Target Range.

Note-4: For Wearing-I mixtures the single sample tolerance shall be 82 % Max and the multiple sample tolerance shall be 80 % Max.

Note-5: For Wearing-IV and 19 mm surface mixtures the single sample tolerance shall be 45 % Min and the multiple sample tolerance shall be 47 % Min.

Note-6: These same criteria shall apply to the 1.18 mm (No. 16) sieve on 4.75 mm and Wearing-III mixtures.

6. QUALITY CONTROL REQUIREMENTS

- 6.1 After the field design verification has been successfully completed, quality control sampling and testing shall continue on the mixture in accordance with the guidelines of this section. Begin sampling on the same day the verification is completed if the estimated remaining quantity delivered to the project is over 200 tons. Daily quality control testing shall consist of a randomly selected asphalt mixture sample taken in accordance with the AASHTO T168 truck bed sampling method for each 1000 tons (900 Mg) delivered to the project with a minimum of one sample per day. The material produced shall conform to the single and multiple sample production tolerances of Table-A. If a new target asphalt content for the design was established in accordance with Section 5.10 of the field design verification procedure then a new moving average for all test requirements of Table-A shall begin with the quality control samples. If the target asphalt content was not changed then the moving average shall continue from the last design verification sample.
- 6.2 Use a random number table or calculator that generates random numbers to select the tonnage at which to sample. See the examples in Section 5.3.1, but change the Sublot size to 1000 tons (900 Mg). Do not take a sample within the first 100 tons (90 Mg) of production during the day unless it consists of mixture that remained in the storage silo in accordance with WVDOH specification from the previous production day. For all new production material for the day take the first sample from the first loaded truck following the truck containing the 100th ton (90th Mg) produced.
- 6.3 When a Sublot is going to represent less than 1000 ton (900 Mg) but at least 200 tons (180 Mg) estimate the tonnage to determine the random sample tonnage. When a Sublot represents less than 200 tons (180 Mg) add it to the previous Sublot.
- 6.3.1 If the Contractor desires, quality control sampling can be moved to the roadway to coincide with the Division's sampling rate as long as samples are taken at the same time and location as the Division's verification samples are taken as described in the sampling materials procedure, MP 401.07.20.
- 6.4 The maximum specific gravity of each test sample shall be calculated and the average daily value of the test samples shall be presented to the DOH for use as the target maximum density of the mixture for determining the density of the project cores taken on the same day. In the event that both QC testing and field design verification are performed during the same day, use the average of all test results.
- 6.5 If any quality control test results fall outside the allowable tolerance limits of Table-A then steps must be taken to make any necessary production adjustments to bring the mix back to within the specification limits.

- 6.5.1 Adjustments to the accepted JMF aggregate proportions shall be made only for the purpose of maintaining the test tolerances of Table-A. The maximum allowable adjustment shall be as indicated in Section 5.10.2.
- 6.5.2 For blend adjustments of over 5%, after corrective action is taken, sample the mixture within 200 tons of production. If a scheduled 1000 ton Sublot sample has already been taken, then this sample will be considered an additional sample. If a Sublot sample has not been taken then this sample may be used as the Sublot sample. For blend adjustments of 5% or less, regularly scheduled Sublot testing may be used. The first sample taken after the adjustment shall be compared to the test results to Table-A for single sample tolerances and (if at least three samples have been tested) multiple sample tolerances.
- 6.5.3 If the sample does not meet both the single and multiple tolerances then suspend production and shipping to the project and determine the cause of the problem. Provide a written explanation of the problem and a proposed solution to the Division. After the Division reviews the proposal and authorizes production to continue, resume production and perform a new JMF field design verification in accordance with Section 5 of this MP. A new moving average shall begin with the third field design verification sample.
- 6.6 The Contractor shall maintain control charts for percent asphalt, percent air voids, percent VMA, and percent passing the 75 μ m (No. 200) sieve. These control charts shall be prepared in accordance with the guidelines of MP 300.00.51. As an alternative method, the control charts may be prepared with a personal computer using software that can generate such charts and provide a distinct graphic representation of all data points. Data points required on the control charts are the daily individual Contractor quality control tests, district verification sample tests, and the moving average of the first three, four, and then five Contractor quality control tests followed by a moving average of five samples. Data points shall be calculated to the nearest 0.1% for all test properties.
- 6.7 For hand drawn charts, the quality control test data points shall be represented by a small blue circle symbol "O" and connected by a dashed line. The moving average data points shall be represented by a small red square symbol "□" and connected by a solid line. District verification sample test data points shall be represented by a small red circle symbol "O", but shall not be connected. The upper and lower tolerance limits of the test properties which were established through the field design verification described in Section 5 shall be represented by solid horizontal lines.
- 6.8 If the computer generated control chart cannot be produced using the symbols and lines described above, then a graph legend shall be included which shall indicate the graphic symbols used to represent the required data points and lines.

- 6.9 The quality control charts shall be kept up to date and placed in a location that is easily accessible to the Division for review at any time.

7. DIVISION ACCEPTANCE AND VERIFICATION SAMPLING AND TESTING

- 7.1 Testing for acceptance is the responsibility of the Division. It shall be based on samples taken at the roadway behind the paver in accordance with MP 401.07.20 using a 2500 ton (2270 Mg) Lot size established in Section 401.7 of the Special Provision.
- 7.2 The Division will obtain a sample from each 500 ton (450 Mg) Sublot and test each sample for asphalt content (AASHTO T 308) and gradation analysis (AASHTO T 30).
- 7.2.1 For each mix design, the Division shall determine the asphalt content correction factor for their ignition ovens and determine if any gradation correction factors (due to aggregate breakdown) are required in accordance with AASHTO T 308.
- 7.2.2 At least two weeks prior to the start of the project the Contractor shall submit to the Division four properly sized laboratory blended samples (samples shall be individually mixed to insure accuracy) containing the target asphalt content for each mix design used on the project. These samples will be used for determining the correction factor for the asphalt content of the mixture. In addition, the Contractor shall submit one laboratory blended blank aggregate sample representing each mix design. This sample shall be used to determine whether or not any aggregate gradation correction factors are required for the mixture. When more than one laboratory ignition oven will be used by the Division then duplicate calibration samples will be required for each. The Division shall inform the Contractor when duplicate samples are needed.
- 7.2.3 These mixture correction factors may be applied to other projects during the paving season, but the Division may request additional blended samples at any time that it is considered necessary to assure accurate test results on the loose mix samples. In all cases, new correction factors must be established each paving season.
- 7.3 Using the average of the Sublot test results for percent asphalt and percent passing the 75 μ m (# 200 sieve), the Division will pay on a Lot-by-Lot basis at the contract unit price, adjusted based on the percent within limits in accordance with MP 401.13.50, using the upper and lower specification limits in Table-B, and the corresponding payment factor percentages as specified in Table 401.13.3.1 in the Section 401 Special Provision.

Table-B
Upper and Lower Specification Limits
For Calculating Percent Within Limits

Mixture Type	Testing Criteria	
	Lower Specification Limit (L)	Upper Specification Limit (U)
	Asphalt Content (%)	
25 mm, 37.5 mm & Base-1	JMF - 0.5	JMF + 0.5
All Other Mix Types	JMF - 0.4	JMF + 0.4
	Percent Passing the 75 μ m (No. 200) Sieve	
All Mix Types	JMF - 2.0	JMF + 2.0

- 7.4 In addition to acceptance testing of asphalt mixtures for asphalt content and gradation analysis, the Division will perform verification testing on each mixture used on the project for percent air voids, percent VMA, and maximum specific gravity. This shall be accomplished by sampling and testing the mixture at a minimum frequency of one test per every ten Contractor quality control tests with a minimum of one sample per project for any mixture in which at least 500 tons (450 Mg) is placed. This shall be done completely independent of the Contractor's quality control activities.
- 7.4.1 These samples shall be taken at the plant from a truck bed and may be obtained at any time during the period that the Contractor is testing ten consecutive samples or during the period that the Contractor is producing at least 500 tons of mixture.
- 7.4.2 The percent air voids, percent VMA, and maximum specific gravity from these verification samples taken by the Division will be statistically evaluated for similarity to the Contractor's quality control tests in accordance with the guidelines of MP 700.00.54. If the evaluation indicates that the Division's test results are similar to the Contractor's test results, then the material represented by this evaluation will be considered acceptable.
- 7.4.3 If dissimilarity is detected, an immediate investigation will be conducted to determine the cause. The intent of the investigation is to define and correct any testing deficiencies that may cause a misrepresentation of the tested material.


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